
XII. *On some remarkable Deviations from the usual Structure of Seeds and Fruits.* By Robert Brown, Esq. F.R.S., Lib. L.S.

Read March 5, 1816.

THE principal part of the following paper was read to the Society in March 1813. It was then withdrawn with a view of rendering it more perfect by additional facts, which I hoped I might be able to collect. Since that time I have not had it in my power to pay much attention to the subject. As, however, the facts formerly stated appear to me of some importance, and are as yet unpublished, I take the liberty of again submitting them to the Society, along with a few additional instances of anomalies in the structure of seeds and fruits, hardly less remarkable than those contained in the original essay.

It is, I believe, generally admitted by physiological botanists, that the seeds of plants are never produced absolutely naked:—in other words, that the integument through some point or process of which impregnation takes place, cannot properly be considered as part of the seed itself.

That such a covering, distinct from the seed, really exists, may in most, perhaps in all, cases be satisfactorily shown by a careful examination of the unimpregnated ovarium, to a part only of whose cavity the ovulum will be found to be attached.

There are, however, many cases where soon after fœcundation, and more remarkably still in the ripe fruit, this integument acquires

quires so complete and intimate a cohesion with the proper coat of the seed as to be no longer either separable or distinguishable from it.

But systematic botanists have generally agreed to term a naked seed not only this kind of fruit, but every monospermous pericarpium bearing a general resemblance to a seed, and whose outer covering, though distinct from the nucleus, is only ruptured after germination commences.

For the purposes of an artificial arrangement this language may perhaps be sufficiently accurate; but in determining the affinities of plants, it is necessary to express by appropriate terms those differences which are no less important than real.

Of the fruits improperly called naked seeds, there are two principal kinds: The first, in which the pericarpium is distinct from the seed, is termed *Akena* by Richard in his excellent *Analyse du Fruit*; the second, in which the pericarpium coheres with the seed, is the *Caryopsis* of the same author.

An *Akena* (or *Achenium*), even in a separate state, may in general be readily determined. But it is not always equally easy to distinguish a *Caryopsis* from a seed. It may indeed be done in certain cases, as in Grasses, by attending to its surface, in which two distinct and distant cicatrices are observable; the one indicating the point of attachment to the parent plant, the other that by which it was fœcundated. In certain other tribes, however, this criterion cannot be had recourse to, the surface of the *Caryopsis* exhibiting but one areola or cicatrix, which includes the closely approximated points of attachment and impregnation: in such cases, the true nature of the fruit can only be determined by its examination in an earlier stage.

But although it must be admitted that an ovulum is never produced without a covering, through some part of which it is
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impregnated; it is still possible to conceive a case in which a ripe seed may be considered as truly naked while retaining its attachment to the parent plant; and this not subsequent to germination, but even preceding the formation of the embryo. For if we suppose, as the immediate effect of impregnation, a swelling of the ovulum without a corresponding enlargement of the ovarium, the consequence will obviously be a premature rupture of the ovarium, and the production of a seed provided with its proper integuments only.

I am not aware that such an economy has hitherto been described; I have observed it, however, in several plants belonging to very different families, and of essentially different structures.

The first of these is *Leontice thalictroides* of Linneus, *Caulophytum thalictroides* of Michaux, who has founded his new genus on a difference of fruit, the nature of which he has entirely misunderstood. It is remarkable that its real structure should have escaped so accurate an observer as M. Richard, through whose hands it is generally understood Michaux's work passed previous to its publication; but the fact may at least serve to show how entirely unexpected such an economy must have been even to that excellent carpologist.

My observations were made in the summer of 1812, on a plant of *Leontice thalictroides*, which flowered and ripened fruit in the royal gardens at Kew. An examination of the unimpregnated ovarium proved it to be in every respect of the same structure with that of the other species of *Leontice*; and essentially the same with the whole order of *Berberides*, to which this genus belongs. A careful inspection of the fruit, in different states, proved also that the "*Drupa stipitata*" of Michaux is in reality a naked seed, that in a very early stage had burst its pericarpium;

the withered remains of which were in most cases visible at the base of the ripe seed. The first error of Michaux naturally led to a series of mistakes; and the naked seed being considered by him as a drupa, the albumen, which is of a horny texture, is described as a "nux cornea crassissima," and the embryo itself as the seed.

But although this account of the fruit of *Leontice thalictroides* be in no respect similar to that given by Michaux, it may perhaps be considered by some as still differing sufficiently from *Leontice* to authorize the establishment of a distinct genus; and that, therefore, the name *Caulophyllum* may be retained, and its character derived from the remarkable circumstance described, namely, the early rupture of its pericarpium. I believe, however, it will be found more expedient to reduce it again to *Leontice*.

For, in the first place, its habit is entirely that of the original species of the genus. And secondly, though the pericarpium of *Leontice Leontopetalum*, which is the type of the genus, remains shut until the ripening of the seeds, and attains a size more than sufficient for the mere purpose of containing them; yet in *Leontice altaica*, a species in other respects more nearly approaching to *L. Leontopetalum* than to *L. thalictroides*, the pericarpium, though it enlarges considerably after impregnation, is ruptured by the seeds long before they have arrived at maturity.

The accompanying drawing, for which I am indebted to my friend Mr. Ferdinand Bauer, will materially assist in explaining the singular economy now described; and may also perhaps render more intelligible the account I proceed to give of the second instance in which I have observed an analogous structure, but to illustrate which I have at present no drawing prepared.

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This second instance occurs in *Peliosanthes Teta* of Andrews's Repository and the Botanical Magazine:

In this monocotyledonous plant, which in 1812 nearly ripened seed in Mr. Lambert's collection at Boyton, the ovarium coheres with the tube of the perianthium or corolla, and has originally three cells, each containing two ovula. Soon after impregnation has taken place, from one to three of these ovula rapidly increase in size, by their pressure prevent the development of the others, and rupture the ovarium, which remains, but little enlarged at the base of the fruit, consisting of from one to three naked berry-like seeds.

In the Botanical Magazine Mr. Ker, in describing a second species of *Peliosanthes**, takes the opportunity of altering in some respects the character of the genus he had previously given, and of adding a description of its supposed pericarpium, from an inspection, as it seems, of the unripe fruit of *Peliosanthes Teta*. It is evident, however, that he is not aware of its real structure; and consequently does not succeed in reconciling its appearance with the unquestionable fact of its having "germen inferum."

There are some cases in which this early opening of the ovarium, instead of being, as in the preceding instances, an irregular bursting, apparently caused by the pressure of the enlarged ovula, is a regular dehiscence in the direction of the suture. Of this *Sterculia platanifolia* and *S. colorata* are remarkable examples; their folliculi after opening, which takes place long before the maturity of the seeds, acquiring the form and texture of leaves, to whose thickened margins the ovula continue firmly attached until they ripen. Another example of this early and regular dehiscence occurs in an undescribed genus of the same family, which differs from *Sterculia platanifolia* in its pericarpium having a terminal wing and a single seed.

* Botan. Magaz. 1532.

In the specimens of a plant lately sent from Brazil by Mr. Sellow, I observe a similar economy. In this case the ovarium, which is originally unilocular with five parietal placentæ, soon after fecundation opens regularly into five equal foliaceous valves, to the inner surface of each of which an indefinite number of ovula are attached.

The genus *Reseda*, whose capsule opens at top at a very early period, may be considered as affording another instance, though much less remarkable, of the same anomaly. And it is possible this may be the real structure in certain cases of which a very different view has been taken.

In the instances of naked seeds now given, the bursting of the pericarpium precedes the distinct formation of the embryo, while the proper coats of the seed remain entire till after its separation from the parent plant, and germination has commenced.

It may not be uninteresting to contrast this economy with that of the Mangroves and other plants of tropical countries, which grow on the shores, and within the influence of the tide. In many of these the embryo, long before the seed loses its original attachment, acquires a very considerable size; and the first effect of this unusual development is the rupture, in most cases succeeded by the complete absorption or disappearance, of the proper integument of the seed. In some instances the development proceeds still further, and the pericarpium itself is perforated by the embryo, which, while preserving its connexion with the parent plant, often attains the length of from eighteen inches to two feet. This happens in *Rhizophora* and *Bruguiera*, or the Mangroves properly so called. In some of the spurious Mangroves, as *Avicennia* and *Ægiceras*, a lesser degree of development takes place, and in general their pericarpia remain entire till they have dropped from the tree. In both cases the final cause of the economy is sufficiently

ciently evident; a greater than ordinary evolution of the embryo being necessary to ensure its vegetation in the unfavourable circumstances in which it is unavoidably placed.

But an analogous structure exists in other plants, where the final cause is less apparent, as in certain species of *Eugenia*, in which the integument of the seed is completely absorbed before its separation from the parent plant, and while the pericarpium remains entire.

An economy no less remarkable than that of the Mangroves; but of a nature diametrically opposite, takes place in the bulb-like seeds of certain liliaceous plants, especially of *Paucratium*, *Crinum* and *Amaryllis*; in some of whose species the seed separates from the plant, and even from the pericarpium, before the embryo becomes visible. This observation respecting some of these seeds was, I believe, first made by Mr. Salisbury; and in such as I have myself examined, I have found the fact connected with one no less interesting, namely, an unusual vascularity in the fleshy substance.

I have in another place*, in speaking of this substance, which constitutes the mass of the seed, and in a central cavity of which the future embryo is formed, stated it to be destitute of vessels, and entirely composed of cellular texture. But on a more careful inspection, of those seeds at least in which the separation precedes the visible formation of the embryo, I now find very distinct spiral vessels:—these enter at the umbilicus, ramify in a regular manner in the substance of the fleshy mass, and appear to have a certain relation to the central cavity where the embryo is afterwards formed, and which, filled with a glairy fluid, is distinctly visible before the separation of the seed. It is a curious consequence of this tardy evolution of the embryo, which in some cases does not

* Prodr. Flor. Nov. Holland. p. 297.

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become visible unless the seed be placed in a situation favourable to germination, that very different directions may be given to its radicular extremity, according to circumstances which we have it in our power to regulate.

There is a fourth kind of anomaly in the structure of certain seeds, which, as I have formerly described it*, I shall here notice in few words. It is that which takes place in certain *Aroideæ*, especially in some species of *Calladium*. In these, the nucleus of the seed is not properly a monocotyledonous embryo, but has an appearance and economy more nearly resembling those of the tuber of a root; for, instead of being distinguishable into a cotyledon, a plumula and radicula, and of germinating in a determinate manner and from a single point, it is composed of a mass whose internal structure is uniform, and on the surface of which frequently more than one germinating point is observable.

None of these anomalies appear to me materially to lessen the importance of the characters derived from the seeds of plants; but they evidently render a minute attention to every circumstance absolutely necessary in all attempts either to deduce affinities or establish genera from this source; and they especially demonstrate the necessity of carefully ascertaining the state of the unimpregnated ovarium; for, while its structure remains unknown, that of the ripe fruit can never be thoroughly understood.

* Prodr. Flor. Nov. Holl. p. 335.

